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Antarctic terrestrial biology: a case for international cooperation

Distinguished guests, ladies and gentlemen, I wish to thank the organizers of the Kiel Symposium on Terrestrial Biology for giving me the opportunity, albeit a difficult one when following such distinguished speakers, to share my thoughts with you.

I am reminded that there was a very popular television show in the United States called "All in the Family". "All in the Family" had a special trait which depicted the frankness family members employ when dealing with each other. As this is like a family gathering here tonight, I would like to do the same thing; share some frank views with you and tell you, unfortunately, that there are a number of things forthcoming which will very much inpact what you may want to do, what you can do, and what may be in the Antarctic.

Let us be reminded that, despite some of our colleagues pretensions, the earth is not flat at 60 degrees South. Indeed, there is a large continent, the Antarctic, which is surrounded by vast, ice covered oceans. This continent, once so remote is now close and, furthermore, its role in our understanding of what happens on this globe in scientific terms becomes more and more important and affects even political decisions. Secondly, I would like to set the stage for our family talk. I will not delve into your scientific work to be discussed at this symposium as I am not a biologist, but a chemist, by training.

In the Antarctic we encounter a range of environmental conditions, from fairly moderate in the Peninsula "Banana Belt" area, to the harshest, coldest desert climate on earth high on the Polar Plateau. Therefore, in terrestrial biology the biota are more determined by physical factors, temperature and the photoperiod, than they are

through biological interactions. There is one notable exception and that is the interaction between the marine and the terrestrial environment as mediated by marine birds. For example, some gulls and skuas feed on limpids and regurgitate the shells, thus providing a substate for fungi, lichens and other lower plants. The terrestrial environment is also enriched by penguin guano. It provides a major source of nutrient input as can be witnessed by an example of a moss field that was created by such guano. The highest link in the Antarctic terrestrial food chain is not very high, there are some mites and collembolas. There are only two flowering plant species; besides a grass which occurs mainly in the Peninsula area, fruticose lichens and crustose lichens can be found anywhere in Antarctica, even within 266 miles of the South Pole. I don't know how this exact number came about, I was not involved in the measurements - regardless, they exist in sunny mountain valleys. As one moves inland, conditions become increasingly desperate, and you know the famous research on "bugs in the rocks", also known as cryptoendolithic microorganisms. I should mention here that there is also a very unique flora in the heated soils on the volcano Mount Melbourne. And finally, we should include the life that exists in the terrestrial fresh water environment in particular Antarctic lakes.

In summary, the Antarctic terrestrial ecosystem comprises relatively few species compared to temperate or tropical regions. They show little interdependence and have developed special adaptations to deep cold, drought, and long cycles of light and darkness. The slower functioning of biological processes in this environment facilitates the study of ecosystem interactions and interrelationships. The relative simplicity of polar ecosystems makes them excellent candidates for modelling efforts.

Let me now introduce a new species in the Antarctic, the highest terrestrial life form known, humans. In my opinion, terrestrial biology in its broadest sense should include the study of human biology and health, and the social and behavioral sciences, because we are introducing a new non-indigenous species on the last continent. This

is particularly true for the human adaptation, and for modern hormone studies and how this experience relates to life in space. I borrowed this phrase from the title of a conference that was just held in California and jointly sponsored by the National Aeronautics and Space Administration and the National Science Foundation. Dr. E. I. Friedmann, a member of this meeting, is present today. One of the most experienced people in the U.S. Antarctic program, he expressed his fascination to me regarding the similarity of the winter over experience in the Antarctic and the experience of people who spend long periods of time in space. We are reminded that in the world of Antarctic microorganisms there exists such similarity, and Chris McKay, is working on a project that relates the "bugs in the rocks" to similar processes on Mars.

Let me go back to the highest terrestrial lifeform. That is where the problem begins. This picture might depict one of the heroic explorers, or an explorer still living. It could be a scientist, it could be a leader of a private expedition. (It could be one of the people around to protect the Antarctic environment.) It could be a commercial tour operator, or could be just a simple bureaucrat, or logistic person associated with any government program. But anyway, despite the good intentions of all these people that this picture symbolizes, they introduce a lot of problems in the conduct of pure scientific undisturbed research on the continent.

I want to introduce the second area I have been asked to discuss, and that is international cooperation in terrestrial biological programs in the Antarctic. Let me review some recent developments in the United States in science policy, and in Antarctic program planning and then derive some suggestions on international cooperation from the U.S. point of view. The National Science Board, the governing board of the Foundation, has just completed a year long study, an indepth review of the Fondation's role in the polar regions. The effort was chaired by Dr. Rita Colwell of the University of Maryland and the committee itself went to the Antarctic, to the Arctic, and heard more than 40 experts on science policy, logistics, funding,

and representatives of the different scientific disciplines who work in the Antarctic. They have written an excellent report which will be made available in the near future. I would like to mention some of the most important recommendations here that relate to our discussion. First of all, they said that science should determine logistics and not the other way around. The committee recommends the establishment of a network of research support centers in the polar regions to be managed by universities or by private organizations. They recommend that in the U.S. we develop a national interagency polar research plan. They recommend that health, safety and environmental protection practices be studied and updated. They recommend the introduction of advanced satellite sensors for research data collection and communication. They recommend an increased NSF role in the development of polar policy - a point on which I will expand further later in my discourse - they recommend that we deal effectively with increasing tourism. They recommend that we develop basic engineering research in support of science and, finally, they recommend that the level of funding for NSF supported polar science be increased to twice the present amount within 3 years. This is not an unrealistic recommendation, in view of the fact that the Reagan Administration has agreed to recommend to Congress that the National Science Foundation's budget be doubled in the next five years. So, I think it is fair to say that the National Science Board has set the NSF on a vigorous course of research in both polar regions.

In keeping with this, we need investment in facilities in the Antarctic to support the sophisticated scientific research that is developing and can take place on the continent. That includes, for instance, the very interesting aspects of carrying our molecular biology in the Antarctic. For this purpose, we will start this season in McMurdo - the construction of a new science laboratory which will be built in stages and house biology, geology, geophysics, atmospheric sciences and other sciences and the necessary support facilities. I think, in keeping with the National Science Board report, we ought to make this a center for science and technology on the Antarctic continent. This is a big step forward compared to the present domination of all Antarctic stations by other considerations.

We will need to change our arrangements in McMurdo insofar as moving industrial activity out of town, and we will need to protect this investment so that it equals the most sophisticated laboratories in the temperate regions, or all our investment will have been in vain. Most importantly, it will require another style of science management. One option we are thinking about would require the science and technology center on the Antarctic continent to be managed by a University consortium, with a fulltime scientific director hired with full responsibility and appropriate staff to guide the activities that we think will take place, including terrestrial biology in the years up to the year 2000 and beyond. The laboratory will be completed in the early 1990's; some phases of it will be ready earlier.

This brings me to another point; the NSF is now involved in establishing science and technology centers. In the United States we have concluded that such centers will have a director and interdisciplinary teams will have more opportunities to deal with interdisciplinary research. We must not forget that any scientific progress depends on the level of technology that is available to support it. These centers, we have already a number of them in engineering research, will be open to proposals from all the disciplines. Other candidates in the polar regions are a global Ice Core Research Center, a center for severe environments, and a center for atmospheric processes in the polar regions. A program announcement for these Science and Technology centers, will be forthcoming from the Foundation in the ensuing weeks.

Getting back to science, there another important initiative. The Foundation has received congressional support for an initiative we call global geosciences. We believe that in the next 20 years all of our knowledge should be put together to understnad our planet earth as a system. Therefore, our progress in oceanography, atmospheric sciences, climate research, earth sciences and biology has to be coordinated. We have succeeded, within the bureaucratic framework, to get the polar science coordinated in this effort. If we do not do that, if we regress back to the flat earth syndrome, we believe

the polar scientific community will be left out of the main stream and will not be able to participate in - what I believe - will be the major thrust for the next 20 years in the geophysical sciences.

Now I would like to turn to some specifics of international cooperation in the Antarctic. First of all, we find that many people who are interested in the Antarctic have never seen the continent. They have no idea of what's going on and what should be done. In most cases, that turns out to be disadvantageous. Indeed, two years ago we built this field camp called Beardmore South Camp, between McMurdo and the South Pole, and we invited a number of international representatives, diplomats and scientists, people concerned about the environment. We had about 60 people for a week in the interior of the Antarctic continent where they freely discussed what the future of the continent should be and they got a first glance of what it means to go to the continent, to travel on the continent, and to live there for a while. This was a great experience for most of them. Unfortunately, when they returned to the outside world the same plitical views and opinions came to the fore again. In the following two years we used this field camp for our scientific research program. We had about sixty earth scientists there, many from other countries and that was our way of saying we share our facilities for international cooperation in a setting that is very hard to match for other nations.

Let me give you some more examples. We have a special relationship with New Zealand, we supported Ganovex of the F.R.G., we had a major study with France on the katabatic winds, and what we call the "National Ozone Expedition" is an international team, not only in the NSF supported parts but also in the NASA funded projects. We have geological programs in the Peninsula with the British Antarctic Survey, and we have benefited, certainly, from international cooperation the other way around with the "Polarstern" of the AWI. Basically, we favor cooperation started by individual scientists. I can think of no better example than the work and contributions made by Dr. Friedmann.

Under a NSF grant, he developed a major new field of research. He also established probably the best cooperation in the NSF sense, with his colleagues, Prof. Hirsch and Prof. Kappen. The scientific results they have achieved speak for themselves and their creation of an international team is just magnificent. However, this example also shows limitations. I know of several discussions with Dr. Friedmann where he told me of the constant challenges to be met with regard to advancing science, and/or devoting more time to administration to keep the group together and to find more funding.

I believe that in terrestrial biology, as we have in other programs, we have to find some new ways of doing business, because the pressure is on. Lets take for a moment a look at the international science in the Antarctic. Of course, the goals of international science are very well represented by the dedicated scientists of "SCAR", (the Scientific Committee of Antarctic Research). In my opinion, the rapid developments in the Antarctic in certain areas - and I will get back to those - combined with political developments make it necessary that SCAR takes a very forward look as to how it will be organized and how it will be able to cope with thechallenges that they find themselves with. Let me give you two examples, one from the scientific area and one from an area that will concern all of you far more than you might ever believe.

Let us take the ozone hole. In actuality it, for short, is not really a hole. It is more of a lense of ozone depletion over the Antarctic. It was first reported by a scientist of the British Antarctic Survey using very basic equipment which had been designed in the 1930's. Some of the most sophisticated equipment ever developed did not detect this hole. Then, it became a crisis and nowadays it is such a crisis that we have political attention in the U.S. Congress, etc. We have international conferences trying to look at the economic side of the problem which is affecting profits and jobs. I find that in the time I have been dealing with this problem the international scientific

community has not come to grips with the situation and it has not shown the ability to deal with this problem.

In my estimation we have a situation where the plitics might affect the planning of the science and our money for those programs. In other words, when the panic arrives, the Congress in the United States might decide the programs. Consequently, funding would be reduced in other programs and I think that is the least desirable way of handling this situation.

I would prefer that we continue in our ability to have a balanced program among all the disciplines because you never know where the next "hole" might be coming from, whether it be a sodium hole or whatever hole. So, I think that the SCAR should try to help the national programs in situations like that, to show what all the nations investments in the Antarctic have been, what the international scientific community can do and what they can do in this particular instance.

Now let me give you another example and that's one that alarms me most. I recently did some extensive traveling to deal with this problem; the problem of NGA, - non-governmental activities. That is tourism, and private expeditions, and in those, I include organizations like Greenpeace, people who wanted to walk to the South Pole, etc. I am deeply concerned with this issue, not only because some of the National Science Board members have started commenting on the excessive bad publicity the Foundation recieves with regard to these private expeditions, but because it is mainly our responsiblity to rescue whoever walks on the continent if they get in trouble. We rescued people who have been stranded in very unpleasant places yet, regardless of our own resources expended or, more importantly, the fact that there may be no injuries incurred, the U.S. government is invariably faced with litigation. A suit pending against the U.S. government for 35 million dollars, for instance, there is the crash of the New Zealand DC 10 aircraft eight years ago. I don't want to with regard to go into details, I am merely trying to explain why I am so alarmed about this issue.

Mass tourism has arrived as well. In Buenos Aires I went into a tourist bureau where I saw an advertisement that a European company had chartered a greek owned ship, which we call a "love boat", which can carry 1000 people and will take you down to the Antarctic for 10 days at $ 680 dollars per person. One can take a trip from Argentina to the Peninsula area and back. This increases the number of people that will come to anyone of our stations by a factor of ten compared to the present rate.

Let's take Palmer Station which houses about 40 people in summer. Now, imagine a tourist ship with almost a thousand people comes in. If all of them come ashore, I don't know how it can be managed technically, but if that happens, we may close it down. No scientific laboratory can absorb this influx. What can we do? We are working in getting agreements among the operators of all international Antarctic programs, based on the recommendations of the Treaty, and based on the findings of the working groups of specialists on logistics of SAR, to come up with a joint approach which we might call a code of conduct for private expeditions which includes, insurance etc., and SCAR responsibility. This is what we are working on and this brings me back to what you have to deal with.

So you are going to study the undisturbed Antarctic terrestrial biology. If this tourist movement goes on, you also will have more problems to study the real pristine Antarctic. I believe, that as far as your science is concerned, it is very important that your community gets organized and agrees quickly on a course of action!

The international investment in the Antarctic in scientific research and logistics offers vast opportunities for cooperation. There are rapid developments in the polar regions! Evermore important political questions require credible results by international standards. In this context Antarctic terrestrial biology is at a critical junction. There is an urgent need to develop long term programs along the concept of BIOTAS. Unfortunately it is only a concept as yet. I believe the

national programs ought to consider this concept seriously at once! The alternative is dismal - The opportunity to observe the bio - component of global change in Antarctica may be lost forever!

Finally, I think, this will be a wonderful symposium. I took the tour this afternoon of the laboratories which I can't do very often, I was really enthused by the research going on. I hope you have a rewarding and fruitful symposium here in Kiel.